PATENT ABSTRACTS OF JAPAN

(11)Publication number : 2002-329504
(43)Date of publication of application : 15.11.2002

(51)Int.Cl. H01M 8/02
H01M 8/10

(21)Application number : 2001-133062
(22)Date of filing : 27.04.2001

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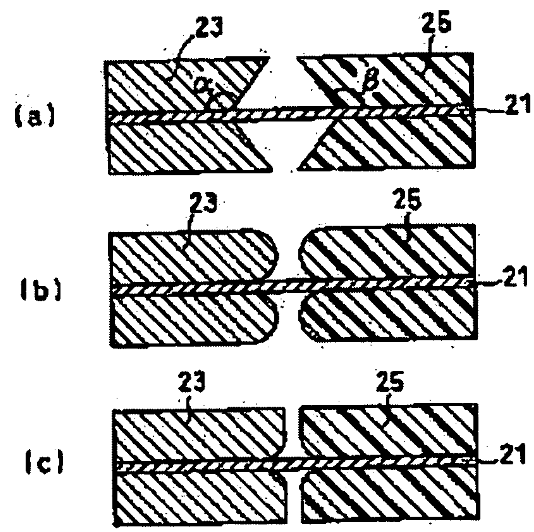
(54) POLYELECTROLYTE FUEL CELL

(57)Abstract:
PROBLEM TO BE SOLVED: To resolve concentration of loads such as differential pressures of fuel and oxidizer gas and vibration to a cell in a polyelectrolyte film portion between a gasket and an electrode and easy fracture of the polyelectrolyte film in an edge part of the electrode or a gasket end face.
SOLUTION: An angle α comprised of an end part face of at least one electrode and a contact surface of the polyelectrolyte film and the electrode is >90° and <180°. An angle β comprised of the end face of the gasket in at least one electrode side and a contact surface of the polyelectrolyte film and the gasket is >90° and <180°. By this, the loads to the polyelectrolyte film are reduced.



LEGAL STATUS
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[Date of sending the examiner's decision of

rejection]

[Kind of final disposal of application other than the examiner's decision of rejection or application converted registration]

[Date of final disposal for application]

[Patent number]

[Date of registration]

[Number of appeal against examiner's decision of rejection]

[Date of requesting appeal against examiner's decision of rejection]

[Date of extinction of right]

CLAIMS

[Claim(s)]
[Claim 1] The electrode of the pair which has the catalyst bed which sandwiches the polyelectrolyte film and said polyelectrolyte film, The anode side conductivity separator plate which has the gas passageway which supplies fuel gas to one side of said electrode, The cathode side conductivity separator plate which has the gas passageway which supplies oxidizer gas to another side of said electrode, and the gasket arranged on the periphery section of each of said electrode are provided. The end face of one [at least] electrode, The polyelectrolyte mold fuel cell characterized by the include angle alpha which the plane of composition of said polyelectrolyte film and said electrode makes being 90 degrees < alpha< 180 degrees.
[Claim 2] The polyelectrolyte mold fuel cell according to claim 1 which is the nonwoven fabric with which the electrode substrate of said electrode consists of a carbon fiber.
[Claim 3] The electrode of the pair which has the catalyst bed which sandwiches the polyelectrolyte film and said polyelectrolyte film, The anode side conductivity separator plate which has the gas passageway which supplies fuel gas to one side of said electrode, The cathode side conductivity separator plate which has the gas passageway which supplies oxidizer gas to another side of said electrode, and the gasket arranged on the periphery section of each of said electrode are provided. The end face by the side of the electrode of one [at least] gasket, The polyelectrolyte mold fuel cell characterized by the include angle beta which the plane of composition of said polyelectrolyte film and said gasket makes being 90 degrees < beta< 180 degrees.
[Claim 4] The polyelectrolyte mold fuel cell according to claim 3 with which said gasket consists of non-conductive elastic resin and non-conductive rigidity resin.
[Claim 5] The polyelectrolyte mold fuel cell according to claim 1 to 4 from which either [at least] said electrode or the gasket is cut by predetermined size with the punching mold.

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* NOTICES *

DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[Field of the Invention] This invention relates to a polyelectrolyte mold fuel cell. It is related with amelioration for the edge surface part which the gasket arranged on the electrode which sandwiches the polyelectrolyte film, and its periphery section in more detail counters.
[0002]
[Description of the Prior Art] A polyelectrolyte mold fuel cell makes fuel gas, such as hydrogen, and oxidation gas, such as air, react electrochemically with a gas diffusion electrode, and makes coincidence generate the electrical and electric equipment and heat. The general configuration of such a polyelectrolyte fuel cell was shown in drawing 1 . In drawing 1 , the catalyst bed 12 used as a principal component sticks the carbon powder which supported the platinum metal catalyst to both sides of the polyelectrolyte film 11 to which a hydrogen ion is conveyed alternatively, and it is arranged. In the external surface of a catalyst bed 12, the diffusion layer 13 of the pair which combines gas permeability and conductivity sticks to this, and is arranged. An electrode 14 is constituted by this diffusion layer 13 and catalyst bed 12. The conductive separator plate 16 is arranged on the outside of an electrode 14. The conductive separator plate 16 has the gas passageway 17 for carrying away the gas which connected adjoining MEA(s) to the serial electrically mutually, and supplied reactant gas to the electrode further, and occurred by the reaction, and excessive gas in one field while fixing mechanically the film-electrode zygote (MEA) formed by the electrode 14 and the polyelectrolyte film 11.
[0003] Although a gas passageway can also be prepared apart from the separator plate 16, its method which establishes a slot in the front face of a separator plate, and is made into a gas passageway is common. The cooling passage 18 which circulates the cooling water for keeping cell temperature constant is established in the field of another side of the separator plate 16. Thus, by circulating cooling water, the heat energy generated by the reaction can be used in the form of warm water etc. By the cell of such a laminating mold, the feed holes of gas and a discharge hole, and the so-called internal manifold mold that secured the feed holes and the discharge hole of cooling water in the interior of a layer built cell further are common.
[0004] In order to prevent the gas leakage to a counter electrode, or the leakage of the gas to the exterior, respectively, the gasket 15 which has a seal function is formed in the periphery section of an electrode 14. An O ring, a rubber-like sheet, the compound sheet of elastic resin and rigid resin, etc. are used for a gasket. The gasket of the composite system which has rigidity to some extent is made to unite with MEA from a viewpoint of the handling nature of MEA in many cases. In the above polyelectrolyte mold fuel cell stacks, in order to reduce the electric contact resistance of component parts, such as a bipolar plate, it is required to bind the whole cell tight constantly. for this reason -- being alike -- it is effective to accumulate many cells on an one direction, to arrange an end plate to those both ends, respectively, and to fix between those two end plates using the member for conclusion. As a bolting method, it is desirable to bind a cell tight to homogeneity as much as possible in a field. From a viewpoint of a mechanical strength, metallic materials,

such as stainless steel, are usually used for members for conclusion, such as an end plate.
[0005]
[Problem(s) to be Solved by the Invention] However, in the polyelectrolyte mold fuel cell which uses the gasket with the above rigidity, loads, such as differential pressure of fuel gas and oxidizer gas and vibration to a cell, focus on the polyelectrolyte film part between a gasket and an electrode, and there is a problem that breakage of the polyelectrolyte film tends to take place in the edge section of an electrode or a gasket end face.
[0006]
[Means for Solving the Problem] In order to solve the above technical problem, the polyelectrolyte mold fuel cell of this invention is characterized by the include angle alpha which the end face of one [at least] electrode and the plane of composition of said polyelectrolyte film and said electrode make being 90 degrees < alpha< 180 degrees. Moreover, it is characterized by the include angle beta which the end face by the side of the electrode of one [at least] gasket and the plane of composition of the polyelectrolyte film and said gasket make being 90 degrees < beta< 180 degrees. As for either [at least] these gaskets or an electrode being joined to the electrolyte membrane is desirable so that it may be formed in predetermined size with a punching mold and the cutting plane and the plane of composition of the gasket and/or electrode which have the cutting plane, and the polyelectrolyte film may become an obtuse angle.
[0007]
[Embodiment of the Invention] In the polyelectrolyte mold fuel cell of this invention, the include angle which the cutting plane of an electrode edge and the plane of composition of the polyelectrolyte film and said electrode make is an obtuse angle as mentioned above. For this reason, it is rare to damage the polyelectrolyte film in the edge section of an electrode edge. Moreover, the include angle which the cutting plane of a gasket edge, and the polyelectrolyte film and the plane of composition of said gasket make is an obtuse angle. Therefore, it is rare to damage the polyelectrolyte film in the edge section of a gasket edge. Furthermore, if both the cutting planes of a gasket and an electrode edge are obtuse angles, breakage of the polyelectrolyte film between a gasket and an electrode will decrease more. As for the electrode substrate of the electrode used for this invention, it is desirable that it is the nonwoven fabric which consists of carbon fibers, such as carbon paper. As for a gasket, it is desirable to consist of non-conductive elastic resin and non-conductive rigidity resin.
[0008] Hereafter, the gestalt of operation of this invention is explained with reference to a drawing. Drawing 2 shows MEA which consists of a gasket 25 of the pair allotted to the periphery section of the polyelectrolyte film 21, the electrode 23 of the pair which sandwiches this, and an electrode. In the electrode periphery section from which breakage of the polyelectrolyte film poses a problem, since the diffusion layer is in contact with the polyelectrolyte film soon, drawing 2 omits and shows the catalyst bed. Drawing 3 is the expanded sectional view of the important section of MEA in the electrode periphery section. In this invention, the include angle alpha which the periphery end face of one [at least] electrode 23 and the plane of composition of the polyelectrolyte film 21 and said electrode 23 make is made into 90 degrees < alpha< 180 degrees. Or the include angle beta which the end face of the gasket 25 by the side of one [at least] electrode, and the polyelectrolyte film 21 and the plane of composition of said gasket 25 make is made into 90 degrees < beta< 180 degrees. At drawing 3 (a), although the end face of an electrode and a gasket has become straight line-like, as shown in drawing 3 (b) and (c), it cannot be overemphasized that the end face of an electrode and a gasket may have a radius of circle. Both drawing 3 shows the most desirable mode with which the electrode of a pair and the gasket of a pair fill the aforementioned conditions.
[0009]
[Example] The suitable example for this invention is explained to a detail, referring to a drawing.
<<example 1>> Particle size was immersed in the chloroplatinic acid water solution in carbon powder several microns or less, and made the front face of carbon powder support a platinum catalyst by reduction processing. The weight ratio of carbon and the supported platinum was set to 1:1. Subsequently, it was

made to distribute in the alcoholic solution of a polyelectrolyte, and the carbon powder which supported this platinum was slurred. On the other hand, after sinking into the aquosity dispersion (Daikin Industries [, LTD.] make: trade name neo chlorofluocarbon ND 1) of a fluororesin carbon paper with a thickness of 400 micrometers it is thin to an electrode, this was dried, it heat-treated at 400 degrees C for 30 minutes, and water repellence was given. Next, the above-mentioned slurry containing carbon powder was applied to homogeneity, and the catalyst bed was formed in one side of water-repellent carbon paper. This was pierced with the punching mold of electrode size, and it considered as the electrode.

[0010] By adjusting the include angle and sense of a cutting edge of a punching mold at this time, as shown in drawing 5 (a), the include angle alpha which the end face of an electrode 23 and the plane of composition of an electrode 23 and the polyelectrolyte film 21 make was made into 135 degrees. Thus, in the center of the polyelectrolyte film, the produced electrode 23 of two sheets was laid on top of both sides of the polyelectrolyte film 21 with larger ** outside a round than an electrode, as the field which has a catalyst bed faced the polyelectrolyte film, respectively, and it was located. Alignment of the composite-material gasket which carried out the laminating to three layers of silicone rubber / polyethylene terephthalate / silicone rubber was carried out to the periphery section of these electrodes, the hotpress was carried out for 5 minutes at 100 degrees C, and MEA was obtained. As shown in drawing 5 (a), the gasket 25 used here was pierced so that the include angle beta of the cutting plane of a edge and the plane of composition of the polyelectrolyte film to make might become 90 degrees, and adjusted the mold. Let the cell constituted using this MEA be Cell A.

[0011] <<example 2>> As shown in drawing 5 (b), MEA was obtained like the example 1 except the include angle beta which the plane of composition of 90 degrees, a gasket, and the polyelectrolyte film and the end face of a gasket make [the include angle alpha which the plane of composition of an electrode and the polyelectrolyte film and the end face of an electrode make] being 135 degrees. Let the cell constituted using this MEA be Cell B.

[0012] <<example 3>> As shown in drawing 5 (c), MEA was obtained like the example 1 except the include angle beta which the plane of composition of 135 degrees, a gasket, and the polyelectrolyte film and the end face of a gasket make [the include angle alpha which the plane of composition of an electrode and the polyelectrolyte film and the end face of an electrode make] being 135 degrees. Let the cell constituted using this MEA be Cell C.

[0013] Example of <<comparison 1>> As shown in drawing 5 (d), MEA was obtained like the example 1 except the include angle beta which the plane of composition of 90 degrees, a gasket, and the polyelectrolyte film and the end face of a gasket make [the include angle alpha which the plane of composition of an electrode and the polyelectrolyte film and the end face of an electrode make] being 90 degrees. Let the cell constituted using this MEA be Cell D.

[0014] In the cell temperature of 75 degrees C, the hydrogen humidified so that a dew-point might become 85 degrees C at an anode was supplied with one atmospheric pressure, the air humidified so that a dew-point might become 75 degrees C at a cathode was supplied with two atmospheric pressures, and it was made to operate about the above cell for 6 hours by 70% of hydrogen utilization factors, 20% of ratios of oxygen utilization, and current density 0.7 A/cm2. The aftercurrent consistency was made into 0 A/cm2, the hydrogen side was permuted by nitrogen, cel temperature was lowered to the room temperature (about 25 degrees C), and the anode and the cathode were left in the state of ordinary pressure sealing for 6 hours. The cycle was repeated by making this actuation condition into 1 cycle. The electrical potential difference in 0.7 A/cm2 to the number of cycles at that time was shown in drawing 6 . As for the cells A, B, and C by examples 1, 2, and 3, drawing 6 shows that the life is long compared with the cell D of the example of a comparison, respectively. When the cell by which the electrical potential difference fell was disassembled and MEA was observed, it was that which is altogether called at the breakage and the pinhole of the polyelectrolyte film in the boundary section of an electrode and a gasket. That is, according to the configuration of an example, it turns out that the load to the electrolyte membrane in the boundary section of

an electrode and a gasket is mitigable.
[0015] Next, the trial which adds acceleration 3G and vibration with a frequency of 20Hz to a cell was performed, having operated each cell on the same conditions as the above, and taking out power by current density 0.7 A/cm2. Change of the electrical potential difference in 0.7 A/cm2 to test time was shown in drawing 7 . As for the cells A, B, and C of an example, drawing 7 shows that the cycle life is long compared with the cell D of the example of a comparison, respectively. When the cell by which the electrical potential difference fell was disassembled and MEA was observed, it was that which is altogether called at the breakage and the pinhole of the polyelectrolyte film in the boundary section of an electrode and a gasket.
[0016] As mentioned above, the structure of this invention shows that the performance degradation by starting and a halt, and vibration of a macromolecule mold fuel cell can be controlled so that clearly. In an example, although the punching mold adjusted the include angle of a cutting plane, also when other forming technique, for example, cutting, thermoforming, etc. adjust the include angle of a cutting plane, the same effectiveness is acquired. Moreover, in an example, although the cutting plane of an electrode and a gasket is a flat, if the include angle which the tangential direction of a cutting plane and the plane of composition of the polyelectrolyte film make is adjusted like an example, even if it will be a curved surface, the same effectiveness is acquired.
[0017]
[Effect of the Invention] According to this invention, the performance degradation by breakage of the polyelectrolyte film between the electrodes and gaskets by the differential pressure of the fuel gas which occurs at the time of actuation of a polyelectrolyte mold fuel cell, and oxidizer gas, the stress by the vibration from the outside, etc. can be controlled as mentioned above.

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* NOTICES *

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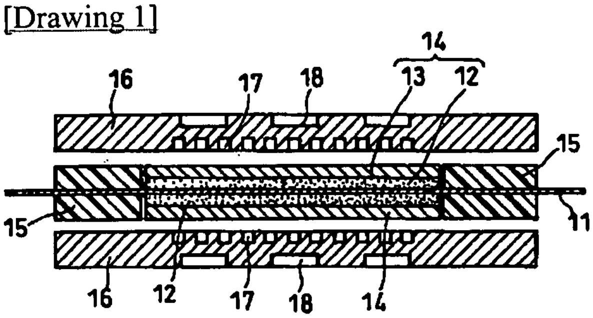
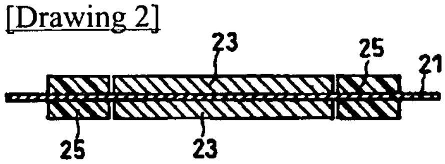
DRAWINGS

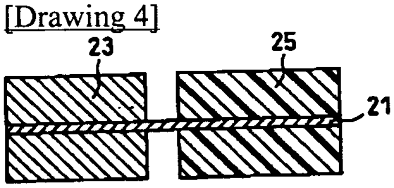
[Drawing 1]



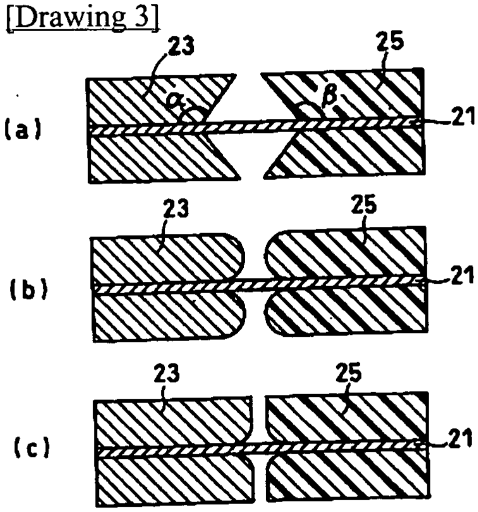
[Drawing 2]



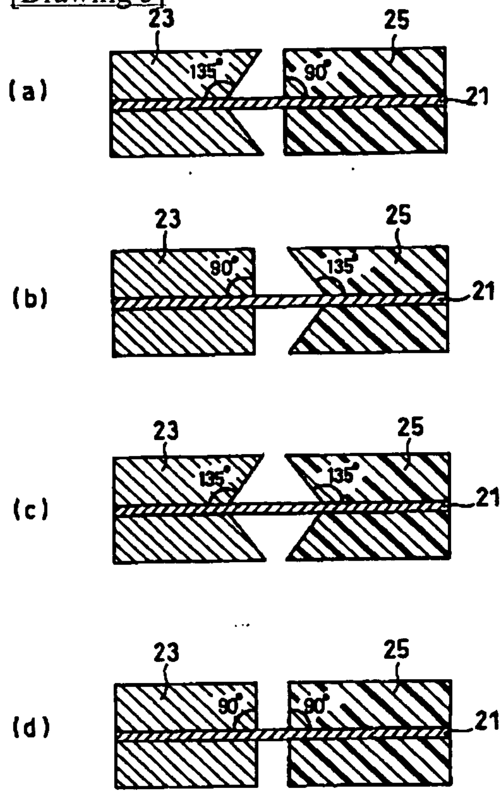
[Drawing 4]



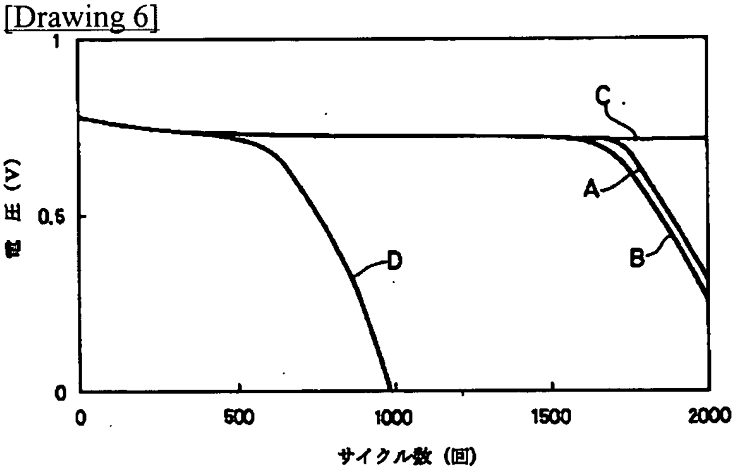
[Drawing 3]



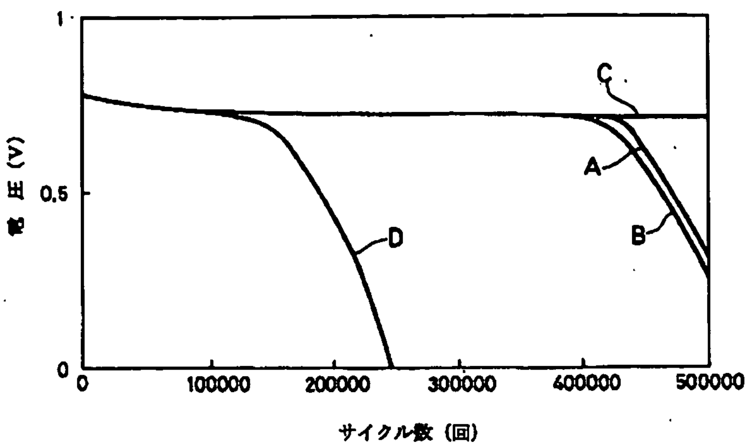
[Drawing 5]



[Drawing 6]



[Drawing 7]



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